Claims

1. A brake system for applying a braking force to a vehicle wheel responsive to a brake force control signal comprising:

a rotor connected for rotation with the vehicle wheel;

a plurality of hydraulic actuators for engaging the rotor to apply the braking force, each hydraulic actuator having:

a working inlet and a working outlet through which a working fluid can be pumped in and out, respectively, responsive to rotation of the rotor;

wherein the working inlets of the plurality of hydraulic actuators are interconnected and the working outlets of the plurality of hydraulic actuators are interconnected;

a brake control unit in fluid communication between the working inlets and the working outlets, and operable, responsive to the brake force control signal, between a brake-off position, providing substantially unrestricted fluid communications between the working outlets and the working inlets, and a brake-on position, providing restricted fluid communications in proportion to the brake force control signal; and

a by-pass valve in fluid communication between the working outlet and the brake control unit and the working inlets, and operable between a by-pass off position, providing substantially unrestricted fluid communications between the working outlets and the brake control unit, and a by-pass on position, providing substantially unrestricted fluid communications between the working outlets and the working inlets thereby by-passing and negating the effect of the brake control unit.

2. The brake system of claim 1, the rotor further comprising:

a substantially disc-shaped main body having two opposed faces; and

a cam surface on each of the two opposing faces;

wherein each of the plurality of hydraulic actuators engagable with one of the cam surfaces.

3. The brake system of claim 2, wherein each of the plurality of hydraulic actuators for engaging one of the cam surfaces engages a different portion of a profile of the cam surface.

4. The brake system of claim 2, wherein an equal number of the plurality of hydraulic actuators can engage each of a first and a second of the cam surfaces.

5. The brake system of claim 2, wherein each of the plurality of hydraulic actuators further comprises a rolling interface for engaging one of the cam surfaces with substantially no frictional resistance to rotation of the rotor relative to the actuator.

6. The brake system of claim 1, wherein the brake force control signal is selected from the group consisting of an electric signal, a hydraulic pressure signal and a pneumatic signal.

7. The brake system of claim 5, each of the plurality of hydraulic actuators further comprising:

a hydraulic cylinder;

a piston for reciprocating movement in the hydraulic cylinder and separating the hydraulic cylinder into a working cavity and an opposing cavity that expand and contract in volume responsive to the back and forth movement of the piston;

a plunger, connected to the piston, retracting into and extending from the hydraulic cylinder responsive to the reciprocating movement of the piston; and

a resilient element biasing the plunger to extend from the hydraulic cylinder;

wherein the rolling interface is disposed at an end of the plunger extending from the hydraulic cylinder.

8. The brake system of claim 7, each of the plurality of hydraulic actuators further comprising a flow direction valve, operable between an actuator-engaged position and an actuator-retracted position, controlling fluid communication between the working cavity and the opposing cavity and between the working cavity and the brake control unit;

wherein the hydraulic actuator is free to engage the rotor when the flow direction valve is in the actuator-engaged position and the hydraulic actuator is retained from engagement when the rotor with the flow direction valve is in the actuator-retracted position.

9. The brake system of claim 8, wherein the flow direction valve is operated into the actuator-engaged position and the actuator-retracted position responsive to the brake control unit being operated into the brake-on position and the brake-off position respectively.

10. A brake system comprising:

a rotor connected for rotation with a vehicle wheel; and

a plurality of brake sub-systems each having:

a hydraulic actuator engagable with the rotor for applying a brake force having:

a working inlet and a working outlet through which a working fluid can be pumped in and out, respectively, responsive to rotation of the rotor;

a brake control unit in fluid communication between the working inlet and the working outlet, and operable, responsive to a brake force control signal, between a brake-off position, providing substantially unrestricted fluid communications between the working outlet and the working inlet, and a brake-on position, providing restricted fluid communications in proportion to the brake force control signal; and

a by-pass valve in fluid communication between the working outlet and the brake control unit and the working inlet, and operable between a by-

pass off position, providing substantially unrestricted fluid communications between the working outlet and the brake control unit, and a by-pass on position, providing substantially unrestricted fluid communications between the working outlet and the working inlet thereby by-passing and negating the effect of the brake control unit;

wherein the working inlets of the plurality of brake sub-systems are interconnected and the working outlets of the plurality of brake sub-systems are interconnected.

11. The brake system of claim 10, the rotor further comprising:

a substantially disc-shaped main body having two opposed faces; and

a cam surface on each of the two opposing faces;

wherein each of the hydraulic actuators engagable with one of the cam surfaces.

12. The brake system of claim 11, wherein each of the hydraulic actuators for engaging one of the cam surfaces engages a different portion of a profile of the cam surface.

13. The brake system of claim 11, wherein an equal number of the hydraulic actuators can engage each of a first and a second of the cam surfaces.

14. The brake system of claim 11, wherein each of the hydraulic actuators further comprises a rolling interface for engaging one of the cam surfaces with substantially no frictional resistance to rotation of the rotor relative to the actuator.

15. The brake system of claim 10, wherein the brake force control signal is selected from the group consisting of an electric signal, a hydraulic pressure signal and a pneumatic signal.

16. The brake system of claim 14, each of the hydraulic actuators further comprising:

a hydraulic cylinder;

a piston for reciprocal movement in the hydraulic cylinder and separating the hydraulic cylinder into a working cavity and an opposing cavity that expand and contract in volume responsive to the back and forth movement of the piston;

a plunger, connected to the piston, retracting into and extending from the hydraulic cylinder responsive to the reciprocal movement of the piston; and

a resilient element biasing the plunger to extend from the hydraulic cylinder;

wherein the rolling interface is disposed at an end of the plunger extending from the hydraulic cylinder.

17. The brake system of claim 16, each of the hydraulic actuators further comprising a flow direction valve, operable between an actuator-engaged position and an actuator-retracted position, controlling fluid communication between the working cavity and the opposing cavity and between the working cavity and the brake control unit;

wherein the hydraulic actuator is free to engage the rotor when the flow direction valve is in the actuator-engaged position and the hydraulic actuator is retained from engagement when the rotor with the flow direction valve is in the actuator-retracted position.

18. The brake system of claim 17, wherein the flow direction valve is operated into the actuator-engaged position and the actuator-retracted position responsive to the brake control unit being operated into the brake-on position and the brake-off position respectively.